Using Math to Untangle DNA
**About the Cover...**

Mariel Vazquez applies mathematical and computational methods to study the mechanism of enzymes that change the topological structure of DNA. **Top left:** The figure represents the path followed by the DNA within the Mu transpososome as proposed by the Harshey lab (UT Austin). Darcy, Luecke and Vazquez provided rigorous mathematical proof that this is the only biologically meaningful configuration that fits the experimental data. **Top right:** The image illustrates a tangle operation. A mathematical tangle is a ball with two strings inside. The object in the figure represents one or more enzymes (blue ball) bound to a circular DNA molecule (yellow loop). Vazquez uses the tangle method to elucidate the mechanism of enzymes that change the topology of DNA. **Bottom left:** Enzymes XerC and Xer D have been shown to disentangle DNA catenanes formed after replication of a circular genome. The figure shows the Xer complex (white ball) acting on one such substrate. Vazquez has won an NSF CAREER award to study the unlinking mechanism by XerCD-FtsK. **Bottom right:** This is a cartoon representation of two interlinked circular DNA molecules produced after replication. As part of her NSF CAREER award, Vazquez aims to understand the mechanism of action of enzymes XerC/XerD as they disentangle these two chains. This work is in collaboration with K. Shimokawa (Saitama University, Japan) and David Sherratt (University of Oxford). All figures were created by Rob Scharein (former SF State research fellow) using the software Knotplot.

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**About the Back Cover...**

The fins on this leafy sea dragon (*Phycodurus eques*) are small and almost invisible. These poor swimmers don't need to swim fast. They rely on being camouflaged among the algae in which they live for protection from predators. Their highly conspicuous “dermal appendages” are unique among the remaining seahorses and pipefishes. These dermal appendages are not used for swimming, but rather to “blend in” as they sway with the swell, along with the surrounding marine seaweeds. Other novel modifications in this group of fishes include male pregnancy—a highly derived reproductive tactic. Scientists are only beginning to understand how such novel features have arisen in evolution, and how such features have contributed to the generation of species diversity. Sea dragons are native to the southern shores of Australia, and are protected worldwide because of their beauty and vulnerability.

*See page 2 for the complete story.*
Novel Appendages:

Fish Genes Reveal Developmental Secrets